REMARKS

This amendment is being filed in response to an Office Action having a mailing date of December 23, 2003. Independent claim 1 is amended as shown to recite certain distinctive features, and to clarify that this claim does not fall within the scope of 35 U.S.C. § 112, sixth paragraph. Claims 2-20 are added. No new matter has been added. With this amendment, claims 1-20 are pending in the application.

In the Office Action, independent claim 1 was rejected under 35 U.S.C. § 103 as being unpatentable over Rosenfeld (U.S. Patent No. 6,307,576 B1). For the reasons set forth below, the applicants respectfully disagree with this rejection and request that all pending claims be allowed.

A disclosed embodiment will now be discussed in comparison to the applied references. Of course, the discussion of the disclosed embodiment, and the discussion of the differences between the disclosed embodiment and subject matter described in the applied references, do not define the scope or interpretation of any of the claims. Instead, such discussed differences are intended to merely help the Examiner appreciate important claim distinctions discussed thereafter.

One embodiment provides a method for video animation, such as head animation wherein an animated three-dimensional video head is generated based on two-dimensional video images. For example, an embodiment may be used to animate an avatar. A method of an embodiment translates an animation vector to a target mix vector, including generating a calibration vector, and mapping the animation vector to the target mix vector using the calibration vector. *See, e.g.*, Figure 1 and the accompanying description in the present application.

Embodiments for translating the animation vector to the target mix vector may be implemented in hardware, software, firmware, or any suitable combination thereof. For example, software code to implement the animation technique are described in page 10, lines 16-25 and elsewhere throughout the present application. Suitable hardware and/or software embodiments to implement the various embodiments are described in the present application,

including example technologies, usable in conjunction with the embodiment(s), that are disclosed in the various publications incorporated by reference.

In contrast to what the applicants have disclosed, Rosenfeld uses techniques that are different. As will be described in further detail below with reference to the claims, Rosenfeld uses a different interpolation process, uses a different type of data, and uses different mapping techniques.

With regards to independent claim 1, the claim as originally filed recited "mapping the animation vector to the target mix vector using the calibration vector." Independent claim 1 is amended to further recite that the mapping involves "using an interpolation in the animation vector between target points" (emphasis added). This is a feature that is not disclosed, taught, or suggested by Rosenfeld, and therefore amended claim 1 is now in allowable form.

More specifically, "keyframes" in Rosenfeld are obtained for detected "phonemes" or for detected "emotemes." Rosenfeld defines a "phoneme" as the smallest unit of speech and which corresponds to a single sound, wherein the occurrence in time of each phoneme is recorded. *See, e.g.*, column 1, lines 32-36 of Rosenfeld. Rosenfeld defines an "emoteme" as timed emotional state data, such as surprise, disgust, embarrassment, etc. *See, e.g.*, column 3, lines 66-67 through column 4, lines 1-3 of Rosenfeld. In Rosenfeld, interpolation is used between keyframes to produce a continuous animation (*see, e.g.*, column 6, line 46 through column 11, line 25 of Rosenfeld) (emphasis added). Column 7, line 11 *et seq.* in Rosenfeld reads as follows: "The uninterpolated morph weight stream has entries only at transition start and end time, however. These act as keyframes. A morph weight set may be evaluated at any time by interpolating between these keyframes, using conventional methods" (emphasis added). Therefore based on this passage in Rosenfeld, this "interpolation" works between keyframes in order to have the model behave consistently between phonemes and emotemes.

In contrast, in an embodiment disclosed in the present application, interpolation is used in the animation vector between target points. The interpolation is done on the input data; the parameters of the mapping are computed by associating an animation vector to every target.

7

For example, an embodiment described on page 3, line 23 *et seq.* describes the mapping as "a multidimensional interpolation in a <u>between the target points</u>" (emphasis added) to obtain an optimal target mix vector corresponding to a given animation vector. *See also* page 2, lines 10-15, describing the relationship between the animation vector a, the target mix matrix g, and so forth.

This distinction has now been reflected in amended claim 1, since amended claim 1 explicitly recites that mapping uses an <u>interpolation in the animation vector between target points</u>. Moreover, there is no motivation to modify Rosenfeld's method to perform its interpolation in the input data, because the interpolation by Rosenfeld is performed over time (*see, e.g.,* the Abstract of Rosenfeld, which describes a sequence of "timed phonemes" and/or other "timed" data). In contrast, amended claim 1 recites interpolation in the animation vector, which would be an interpolation that is independent of time.

The various new dependent claims 2-7 are described next, so as to further emphasize distinctive features between the subject matter recited therein and the techniques disclosed by Rosenfeld. Beginning first with newly added dependent claim 2, this claim recites that the mapping of the animation vector to the target mix vector using the calibration vector is <u>automatically</u> performed. Rosenfeld has to <u>manually</u> create <u>sets of rules</u> that are used depending on the phoneme or emoteme. For example, column 6, line 46 *et seq.* of Rosenfeld states "In operation and use, the user must <u>manually</u> set up default correspondence <u>rules</u> between all visual phoneme groups and morph weight sets. To do this, the user preferably specifies the morph weight sets which correspond to the model speaking... Next, default <u>rules</u> must be specified" (emphasis added).

In contrast, an embodiment disclosed in the present application defines a <u>single function</u> (a multiplication), rather than <u>sets of rules</u>, that map an animation vector to a mix of morph targets using an appropriate interpolating function. The interpolating function contains a set of parameters that can be <u>automatically</u> calibrated. For example, page 3, lines 16-22 of the present application discusses methods to automatically compute the parameters of the mapping using "ground truth anchors to simulate tracking on the model."

More specifically in an embodiment, the facial sensing determines a set of facial landmarks that are tracked and help define at least a portion of the animation vector. An automatic calibration is possible if the model is provided with a set of markers that correspond to the facial landmarks that are tracked. The calibration of an embodiment includes finding the optimal parameters of the mapping that minimizes the distance between the sensed facial landmarks in the images and the re-projected corresponding markers for the animated model. Because Rosenfeld clearly describes a method where the user has to manually set up the default correspondence rules between all phoneme groups and morph weight sets, the automatic mapping recited in new dependent claim 2 is distinguishable over Rosenfeld.

Dependent claim 3 recites that the mapping the animation vector to the target mix vector using the calibration vector includes <u>multiplying</u> the animation vector by the calibration vector, which comprises a <u>diagonal matrix</u>. Support for this claim can be found, for instance, on page 2 lines 8-9 of the present application and elsewhere. There is nothing disclosed, taught, or suggested in Rosenfeld that involves multiplication of an animation vector by a calibration vector in the form of a diagonal matrix. For example and as described above, Rosenfeld requires that the default correspondence rules be manually specified by the user, which does not involve or in any way disclose multiplication using a diagonal matrix as claimed in claim 3.

Dependent claim 4 recites that the mapping includes using a linear mapping technique. According to page 2, line 4 *et seq.* of the present application, for various embodiments, "different mapping algorithms may be used. The common goal is to provide a reasonable interpolation between the points in animation space associated with the targets. Each mapping algorithm is exactly defined by a set of parameters. The parameters vary from algorithm to algorithm." One or more embodiments of linear mapping are described in further detail on page 4 through page 5 and elsewhere in the present application. Nowhere does Rosenfeld disclose, teach, or suggest use of linear mapping in the manner recited in claim 4, and therefore, claim 4 is allowable over Rosenfeld.

Dependent claim 5 recites that the mapping uses a set of basis functions as input, and further recites including using radial basis function mapping. Support for this claim can be found, for example, on page 5, lines 5-20, and elsewhere in the present application. Nowhere

9

does Rosenfeld disclose, teach, or suggest use of basis functions as input and/or use of a radial basis function for mapping. Accordingly, claim 5 is allowable over Rosenfeld.

Dependent claim 6 recites dividing targets into independent groups of target points, and applying different mapping algorithms to different groups of target points. Support for the recitations in this claim can be found, for example, on page 3, lines 6-8 of the present application. Rosenfeld is completely silent with regards to application of different mapping algorithms to different groups of target points, and therefore, claim 6 is allowable over Rosenfeld.

Dependent claim 7 recites that the method further comprises using audio-visual sensing to track facial features for the animation vector. Support for this claim can be found, for instance, on page 1, lines 29-30, page 15, lines 5-12, and elsewhere in the present application. This feature is not disclosed, taught, or suggested by Rosenfeld, since Rosenfeld is completely silent with regards to use of visual sensing techniques to track facial features in a video stream. Rather, Rosenfeld uses phonemes and emotemes, which are defined states.

For instance, Rosenfeld describes how to animate 3-D model using phonemes (and emotional state data of emotemes). This is a completely different type of data input than what is recited in claim 7. A given phoneme is associated to a morph target or a morph target mix by simple rules in Rosenfeld. Examples of rules are given in Rosenfeld, for example, on column 7, lines 60 *et seq.* A complete set of rules and morph targets allow animation of a model mouth based on a stream of phonemes.

In contrast in the present application, the animation data of an embodiment comes directly from tracked facial features in a video stream. An embodiment of the animation vector discussed in the present application is richer than just phonemes or emotemes, as the animation vector can describe complex expressions. An embodiment described by the applicants can actually map automatically nuances of continuous expressions that are sensed or tracked from a video stream. Dependent claim 7 reflects this distinctive feature by reciting that the audio-visual sensing is used to track facial features <u>for the animation vector.</u>

New claims 8-13 relate to an article of manufacture comprising a machine-readable medium having instructions stored thereon. For instance, these claims can cover a

software implementation that performs an embodiment of the method described herein. Independent claim 8 is allowable because it recites instructions to <u>automatically map</u> the animation vector to the target mix vector using the calibration vector. As discussed previously, Rosenfeld uses a <u>manual</u> technique that requires the user to define a set of rules to associate phonemes with morph sets. The "mapping" of Rosenfeld is not automatic. Accordingly, new claim 8 is allowable over Rosenfeld.

Dependent claims 9-13 respectively recite the distinctive features of: instructions to map using an interpolation in the animation vector between target points, multiply the animation vector by the calibration vector that comprises a diagonal matrix, map using a set of basis functions as input, map using linear mapping, and map using radial basis function mapping. None of these features are disclosed, taught, or suggested by Rosenfeld, and therefore, these claims are allowable.

New claims 14-20 are system claims, using means-plus-function language, that have recitations that are distinctive over Rosenfeld. For the sake of brevity, these recitations will not be described in further detail herein. Instead, the Examiner is kindly requested to review the discussion above with reference to the various embodiments provided by the applicants and how these embodiments are different than those disclosed in Rosenfeld. Claims 14-20 are allowable over Rosenfeld.

The applicants have changed attorneys and correspondence address. A new Power of Attorney was filed on December 18, 2003, but was not entered by the U.S. Patent and Trademark Office until after the mailing date of the present Office Action. Accordingly, the present Office Action was mailed to the address of former counsel. The Examiner is kindly requested to review the status of the present application prior to the mailing of the next communication, to verify that the address of record has been officially changed to Seed Intellectual Property Law Group PLLC (Customer No. 00500) at the address below.

Seed Intellectual Property Law Group PLLC
701 Fifth Avenue, Suite 6300
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A copy of the present Office Action was facsimiled to the undersigned attorney by the Examiner on January 15, 2004, after the undersigned attorney informed the Examiner of the change of correspondence address via telephone and after the Office Action was mailed. The undersigned attorney thanks the Examiner for faxing the Office Action.

The applicants note that the faxed copy of the Office Action did not include a list of references cited or copies of two previously filed forms PTO-1449 that listed various references. For example, on October 18, 2002, prior counsel filed an Information Disclosure Statement (IDS), in which copies of 89 references were submitted and listed in the form PTO-1449. In a Supplemental IDS filed on December 10, 2002, prior counsel submitted 6 additional references listed on a form PTO-1449. The Examiner is kindly requested to provide the initialed copies of both of these forms PTO-1449 with the next communication, as well as a list of any other references cited by the Examiner, so that the issued patent will properly list and reflect that all references have been considered by the Examiner.

Overall, none of the references singly or in any motivated combination disclose, teach, or suggest what is recited in the independent claims. Thus, given the above amendments and accompanying remarks, the independent claims are now in condition for allowance. The dependent claims that depend directly or indirectly on these independent claims are likewise allowable based on at least the same reasons and based on the recitations contained in each dependent claim.
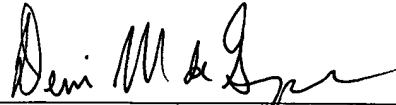
If the undersigned attorney has overlooked a teaching in any of the cited references that is relevant to the allowability of the claims, the Examiner is requested to specifically point out where such teaching may be found. Further, if there are any informalities or questions that can be addressed via telephone, the Examiner is encouraged to contact the undersigned attorney at (206) 622-4900.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

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13